PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Sequestration

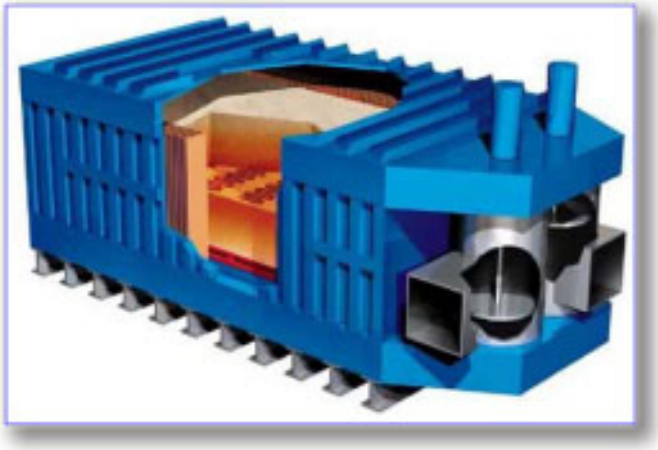
02/2004

CAPTURE AND USE OF COAL MINE VENTILATION AIR METHANE

Background

Methane emissions from coal mines represent about 10% of the U.S. anthropogenic methane released to the atmosphere. Methane, the second most important non-water greenhouse gas, is 21 times as powerful as CO_2 in its postulated global warming effect. Ventilation air methane (VAM), that is, methane in the exhaust air from underground coal mines, is the largest source of coal mine methane, accounting for about 60% of the methane emitted from coal mines in the U.S. Unfortunately, because of the low concentration of methane (0.3-1.5%) in ventilation air, it is difficult to use the methane beneficially. However, oxidizing methane to CO_2 and water reduces its global warming potential by 87%. A potential way to oxidize the methane is by use of a thermal flow reversal reactor (TFRR).

The TFRR technology employs the principle of regenerative heat exchange between a gas and a solid bed of a heat exchange medium. VAM flows into and through the reactor in one direction, and the temperature is increased until the methane is oxidized. The hot products of oxidation then lose heat as they continue toward the far side of the bed. At a specified interval, the flow is automatically reversed, so that the part of the bed that was previously heated now heats the incoming gas. Through the use of heat exchange, excess heat may be transferred for local heating needs or for the production of electric power.



Internal View of TFRR - Visible are heating coil, insulation, switching valves, and air plenum

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PARTNERS

CONSOL Energy

COST

Total Project Value:
$2,029,646

DOE/Non-DOE Share:
$1,623,716 / $405,930

MEGTEC manufactures such a reactor, which they call VOCSIDIZER. The VOCSIDIZER system consists of a large bed of ceramic material in an airtight steel container. A process fan forces the ventilation air into the plenum chamber either above or below the bed. Valves typically reverse flow every two minutes. Electrical heating elements heat the center of the bed to 1,832°F at startup, and the reversal of the flow through the bed keeps the center hot during operation.

Contingent upon MSHA approval, CONSOL Energy will demonstrate a commercial-scale (60,000 cfm of ventilation air) VOCSIDIZER oxidation system sited at an operating coal mine for a one-year period. The project includes site selection and permitting, detailed design of the oxidation system, procurement, start up, and commissioning of the system. This will be followed by 12 months of operation. The performance data generated will allow the feasibility and economics of energy recovery from the system to be determined. An engineering and economic analysis of a 180,000 cfm system (sized to consume the majority of VAM from a large mine), including energy recovery, will be conducted.

Potential test site at CONSOL's mine ventilation fan in Southwest Pennsylvania

Primary Project Goal

The primary goal is to determine the long-term technical and economic feasibility of applying a full-scale TFRR system to the safe and efficient oxidation of VAM from operation of a large underground coal mine.

Objectives

- Design an effective interface between the TFRR and the mine ventilation system that does not compromise mine safety
- Convert the low and variable concentration of methane in the coal mine ventilation air to carbon dioxide effectively and efficiently
- Determine the cost of applying the technology
- Determine the quantity of useful energy that can be economically produced

Accomplishments

- Basic designs have been prepared
- Negotiations are underway with MSHA to permit the TFRR unit at an active coal mine

Benefits

The CONSOL team proposes to demonstrate the capture and use of coal mine VAM through use of a full-scale TFRR system. This technology holds the potential to significantly reduce the global warming tendency of the methane emitted from underground coal mines while simultaneously permitting the recovery of useful energy. Once demonstrated, this technology could be applied on a large scale and make a major contribution to reducing greenhouse gas emissions.